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CLAIMS

1. A method for automatic dose control of a liquid treatment chemical during a liquid treatment process within a treatment system, the system having an influent flow and an effluent flow, the method comprising:

a. measuring the liquid flow rate through the treatment system and generating a liquid flow rate signal from the measurement;

b. measuring the concentration of a chemical within the treatment system and generating a chemical concentration signal from the measurement;

c. transmitting the signal generated from step (a) and the signal generated from step (b) to a chemical dosing controller;

d. automatically calculating the dosage of a chemical from signals supplied to the chemical dosing controller;

e. transmitting an output signal from the chemical dosing controller to a chemical feeding system, the output signal based on dosage calculated in step (d);

f. releasing the chemical from step d into influent flow in response to output signal of step (e); and

g. repeating steps (a)-(f) continuously during the liquid treatment process.

2. The method of claim 1 wherein the of liquid flow rate is measured in the influent flow of the system.

3. The method of claim 1 wherein the liquid flow rate is measured in the effluent flow of the system.

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4. The method of claim 1 wherein the liquid flow rate is adjusted by a ~~flow~~ pace multiplier.

5. The method of claim 1 wherein the concentration of the chemical in step (b) is measured in the influent flow of the system.

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6. The method of claim 1 wherein the concentration of the chemical in step (b) is measured in the effluent flow of the system.

7. The method of claim 1 wherein the concentration of the chemical in step (b) is measured both in the effluent flow and in the influent flow of the system.

8. The method of claim 1 wherein the chemical in step (b) is the same chemical as in step (d).

9. The method of claim 1 wherein the chemical in step (b) is a different chemical from the chemical in step (d).

10. The method of claim 1 wherein the measurement of the liquid flow rate in step (a) and the concentration of the chemical in step (b) is performed continuously.

11. The method of claim 1 wherein the measurement of the liquid flow rate in step (a) is continuous and the measurement of the concentration of the chemical in step (b) is performed at intervals within a range of from a fraction of a second to approximately 15 minute intervals.

12. The method of claim 1 wherein the liquid of the liquid treatment process is water and the treatment process is a water treatment process.

13. A method for automatic dose control of nitrate-nitrogen during a water treatment process within a denitrification treatment system using a chemical source of organic carbon as the feed chemical, the system having an influent flow and an effluent flow, the method comprising:

a. measuring the water flow rate through the treatment system and generating a water flow rate signal from the measurement;

b. measuring the concentration of nitrate-nitrogen within the influent flow of the treatment system and generating a chemical concentration signal from the measurement;

c. transmitting the signal generated from step (a) and the signal generated from step (b) to a chemical dosing controller;

d. automatically adjusting the nitrate/nitrogen signal by at least one adjustable dose factor;

e. automatically calculating the dosage of the feed chemical from adjusted signals supplied to chemical dosing controller;

f. transmitting an output signal from the chemical dosing controller to a chemical feeding system, the output signal based on dosage calculated in step (e);

g. releasing the feed chemical into the influent flow in response to the output signal of step (f); and

h. repeating steps (a)-(g) continuously during the denitrification process.

14. The method of claim 13 wherein the feed chemical is selected from the group consisting of alcohol and volatile fatty acid.

15. The method of claim 14 wherein the feed chemical is methanol.

16. The method of claim 13 wherein the water flow rate signal of step (c) is automatically adjusted by a flow pace multiplier.

17. The method of claim 13 wherein the concentration of the nitrate-nitrogen is measured both at the effluent flow and at the influent flow of the system.

18. The method of claim 17 wherein a setpoint for effluent nitrate-nitrogen is selected, an effluent flow concentration signal is generated from the measurement of concentration of nitrate-nitrogen in the effluent flow and the concentration signal is transmitted to the chemical dosing controller.

19. The method of claim 18 wherein the difference between the effluent concentration of nitrate-nitrogen and the setpoint is calculated to generate a control response, the control response is adjusted by one or more sensitivity factors and the adjusted control response is automatically incorporated into the calculation for the dosage of the feed chemical.

20. The method of claim 19 wherein the dosage is used to generate a modified output signal which is transmitted from the chemical dosing controller to the chemical feeding system.

21. The method of claim 20 wherein the modified output signal from the chemical dosing controller to the chemical feeding system is transmitted after a reset time.

22. The method of claim 21 wherein the reset time is input manually.

23. The method of claim 21 wherein the reset time is an automatically calculated variable based on the hydraulic residence time through the process and the process reaction time.

24. The method of claim 18 wherein the nitrate-nitrogen signal is automatically adjusted by at least one adjustable dose factor.

25. A method for automatic dose control of nitrate-nitrogen during a water treatment process within a denitrification treatment system using a chemical source of organic carbon as the feed chemical, the system having an influent flow and an effluent flow, the method comprising:

a. selecting a setpoint for effluent nitrate-nitrogen;

b. measuring the water flow rate through the treatment system and generating a water flow rate signal from the measurement;

c. measuring the concentration of nitrate-nitrogen in the effluent flow and generating a chemical concentration signal from the measurement;

d. transmitting the signal generated from step (b) and the signal generated from step (c) to a chemical dosing controller;

e. calculating the difference between the effluent concentration of nitrate-nitrogen and the setpoint to generate a control response;

f. adjusting the control response by one or more sensitivity factors;

g. automatically calculating the dosage of the feed chemical from the control response;

h. transmitting output signal from chemical dosing controller to the chemical feeding system, the output signal based on dosage calculated in step (g);

i. releasing the feed chemical into influent flow in response to output signal of step (h); and

j. repeating steps (a)-(i) continuously during the denitrification process.

26. The method of claim 25 wherein the concentration of nitrate-nitrogen is measured in both the influent flow and the effluent flow.

27. The method of claim 26 wherein the concentration of the of nitrate-nitrogen in the influent flow is measured and an influent flow concentration signal is generated and transmitted to the chemical dosing controller.

28. The method of claim 27 wherein the influent flow concentration signal is adjusted by an adjustable dose factor and the water flow rate signal from step (d) is adjusted by a flow pace multiplier.

29. The method of claim 27 wherein the calculation of an output signal from the chemical dosing controller to the chemical feeding system is based on water flow rate, concentration of nitrate-nitrogen in the influent flow and concentration of nitrate-nitrogen in the effluent flow.

30. The method of claim 25 wherein the calculation of succeeding control responses in step (e) is performed after a reset time.

31. The method of claim 30 wherein the reset time is input manually.

32. The method of claim 30 wherein the reset time is an automatically calculated variable based on the hydraulic residence time through the process and the process reaction time.

33. The method of claim 30 wherein a derivative control response is generated to counteract rapid rates of change towards or away from the setpoint.

34. The method of claim 33 wherein a derivative control response is generated by determining a first effluent concentration prior to the reset time, a second effluent concentration is measured at the reset time, comparing the first effluent concentration to the second effluent concentration and adjusting the control response accordingly.

35. A method for automatic dose control of a liquid treatment chemical during a treatment process within a liquid treatment system using a feed chemical, the system having an influent flow and an effluent flow, the method comprising:

a. selecting a setpoint for a chemical in the effluent flow;

b. measuring the liquid flow rate through the treatment system and generating a liquid flow rate signal from the measurement;

c. measuring the concentration of the chemical of step (a) in the influent flow and generating an influent chemical concentration signal from the measurement;

d. measuring the concentration of the chemical of step (a) in the effluent flow and generating an effluent chemical concentration signal from the measurement;

e. transmitting the signal generated from step (b) to a chemical dosing controller and generating a primary control response;

f. adjusting the primary control response by a flow pace modifier;

g. transmitting the signal generated from step (c) to a chemical dosing controller and generating a secondary control response;

h. adjusting the secondary control response by an adjustable dose factor;

i. transmitting the signal from step (d) to the chemical dosing controller and calculating the difference between the effluent chemical concentration and the setpoint to generate a tertiary control response;

j. adjusting the tertiary control response by one or more sensitivity factors;

k. continuously calculating the dosage of the feed chemical from the primary control response and secondary control response while incorporating the tertiary control response from step (f) after a reset period;

l. transmitting an output signal from chemical dosing controller to a chemical feeding system, the output signal based on dosage calculated in step (k);

m. releasing a feed chemical into influent flow in response to output signal of step (l); and

n. repeating steps (a)-(m) continuously during the treatment process.

36. The method of claim 35 wherein the chemical in step (a) is the same chemical as in step (m).

37. The method of claim 35 wherein the chemical in step (a) is a different chemical from the chemical in step (m).

38. The method of claim 35 wherein the reset time is input manually.

39. The method of claim 35 wherein the reset time is an automatically calculated variable based on the hydraulic residence time through the process and the process reaction time.